CONSIDERATIONS ON THE APPLICATION OF THE PRINCIPLES OF COMPUTER-AIDED DESIGN TO SPRINKLER IRRIGATION SYSTEMS

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ABSTRACT

This paper aims to demonstrate the successful applicability of the general principles of the computer- aided design to the sprinkler irrigation systems. In other words there were applied commands and traditional design methods for determining the 2D/3D documentation related to a shock sprinkler system. Basically the paper summarized all stages of modelling and setting needed both to obtain 3D models for each item separately including the assembly and for automatic generation of the orthogonal and axonometric projections in the execution drawings.

KEYWORDS: CAD, Mechanical Desktop 6

1. GENERAL ON IRRIGATION SYSTEMS

Irrigation in a wider sense means all the work for artificial watering of the soil, including water supply works usually made through a system of canals and pipelines, hoses and hose reel systems in order to increase soil fertility and therefore better crops. The main purpose of irrigation is to decrease soil water deficit, both on land exposed to drought and land areas that require additional water due to crops. Based on the purpose aforesaid, irrigation may fall under the following categories [3]:

✔ Supply irrigation to ensure the amount of water in the soil before the growing season.

✔ Wetting irrigation intended to reduce soil moisture deficit during the growing season.

✔ Fertilization irrigation providing, under certain controllable concentrations, the necessary amount of chemical fertilizer as required by the soil.

✔ Irrigation of fruit ripening pursuing accelerated aging or pigmentation process to give fruits a more attractive appearance. The 4 methods of watering the soil: submersion, leaking to the surface on furrows or strips, underground irrigation and sprinkling, should meet the requirement of uniform distribution of the irrigation water in compliance with the irrigation norms. If wetting by submersion is specifically related to rice culture, being used exclusively in this culture, the other three have also special destinations. Thus, the surface flowing on sloping furrows between rows of plants, soak the soil in depth and laterally by gravity and capillary action, therefore it is recommended for cereals. Underground watering using tubes or galleries and gutters, although allowing for soil wetting by gravity and capillaries, has limited applicability, while sprinkling generating artificial rain through sprinklers, is used in almost all cultures. Depending on how the rotation of sprinklers may be, there is vertical or horizontal rotation. To this second category belongs the sprinkler with oscillating blade and shock, which is the theme of the present work, by applying the principles of parametric modelling in order to obtain a 3D parameterized set. The main components of such a sprinkler, illustrated in fig. 1, are as follows [2]: 1- nozzle; 2- deflector; 3- oscillating arm; 4- helical spring; 5- adjusting ring; 6- pivot; 7- lower body.
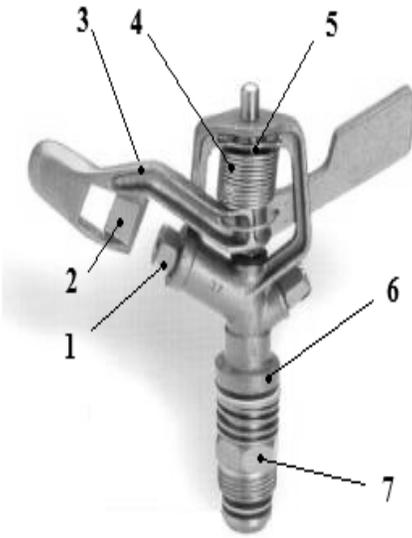
Fig. 1 Composition of a shock sprinkler

Mention should be made that structurally there are many variants of constructions, and they all meet the same operation principle.

2. MODELING STEPS APPLICABLE TO THE GENERATION OF SPRINKLER PARTS

Any modelling in Mechanical Desktop should run through the following stages [1]:

1. Introduction of basic work plans with the command "Ambasicplanes".

2. Choosing an outlining plan with command "New Sketch Plane".

3. Drawing a 2D sketch using specific commands.

4. Rotating in space of a work plan with command "Amdt_sketch_view" until it becomes perpendicular to the viewing direction.

5. Transforming the sketch into open or closed profile with command "Amprofile".

6. Listing all geometric elements with the command "Ampardim" and adding 2D restrictions with the set of commands "Amdt_launch_2dconstraints". The occurrence on the command line of the message "Fully Solved constrained sketch" means that the quotation/sizing and adding of 2D restrictions is completed.

7. Implementation of various three-dimensional shapes using specific commands.

All these steps cause chronological occurrence in the browser of the left window all commands achieved with the 3D model of "part" type as shown in Figure 2.

If the piece is more complex then obviously the browser will contain more commands used, as shown in figure 3, where the 3D model of a sprinkler oscillating arm is illustrated.
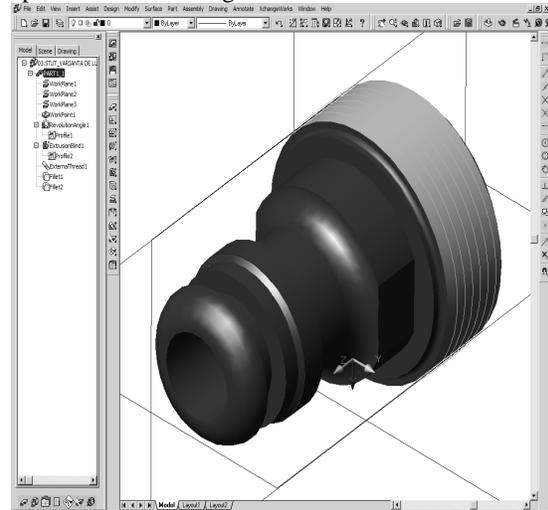
Fig. 2 Window generating a sprinkler nozzle
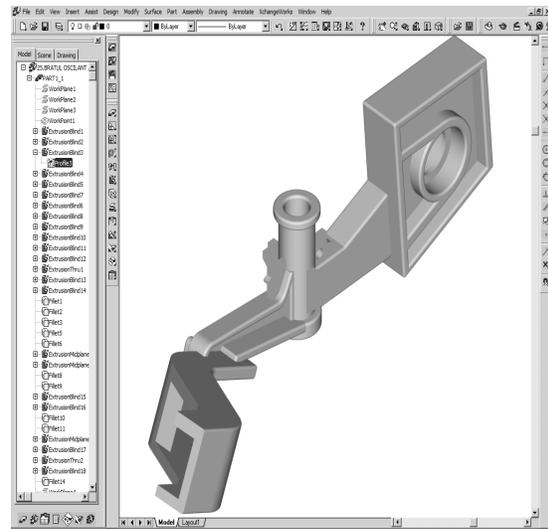
Fig. 3 Sprinkler oscillating arm

3. STEPS FOR OBTAINING EXECUTION DRAWING

In order to obtain orthogonal and axonometric projections related to the execution drawings, the following steps must be run through:

1. Set both the properties and dimensions of a worksheet with commands "New Layout" and "Plot". In the second command it shall be set the type of printer, the printing properties, size, and paper size, orientation of "Portrait" or "Landscape" type and print scale. All these settings are shown in Figure 4.
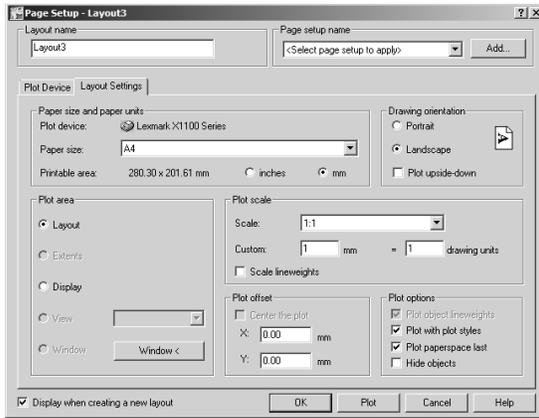
Fig. 4 „Plot" window

2. Starting from the pull-down "Drawing" the command to obtain orthogonal or axonometric projections using one of the options "Multiple Views" or "New View". If the first variant is recommended for beginners as they instantly get all types of view projections, the second is intended for advanced users, as it allows, based on the first projection, to obtain immediately the next step, projections containing sections.
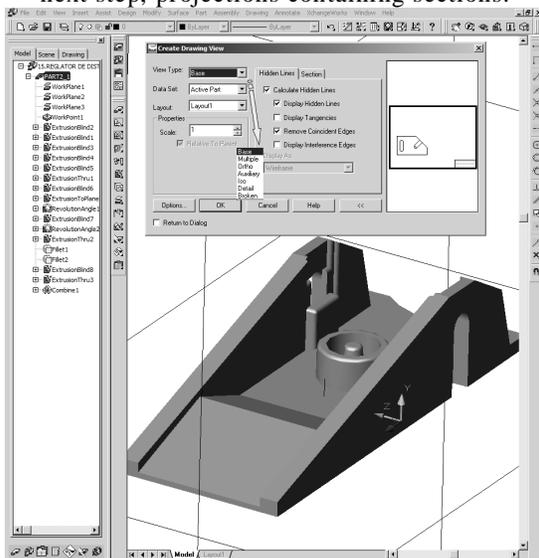
Fig. 5 Setting "Drawing" command

In Figure 5 it can be seen the parameters controlled by the user when activating the drawing command, namely:
- ✓ Defining the type of projection (Base, Multiple, Ortho, Auxiliary, Iso, Detail, Broken);
- ✓ Establishing the set of data of the type„Active Part", „Scene", „Group", „Select";
- ✓ Selecting the worksheet „Layout";
- ✓ Establishing the drawing scale;
- ✓ Imposition of the settings to the covered

lines
- ✓ Establishing the type of section (Full, Offset, or Breakout).

3. Setting the thickness of the drawing lines and colours used for all annotations in the drawing is done in the window of Figure 6 corresponding to the command "Layer Properties Manage"
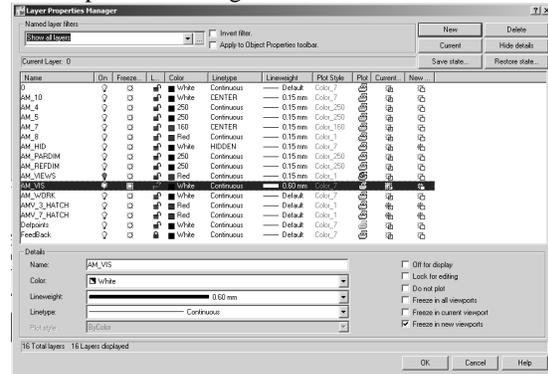
Fig. 6 „Layer Properties Manager" window

4. It should be noted that in the "Layout" window is not permitted to view with a thick line the exterior or interior contour edges, but due to setting parameter "Lineweight" for layer "AM_VIS", the printed design shown in Figure 7 meets thick line visualization of visible edges.
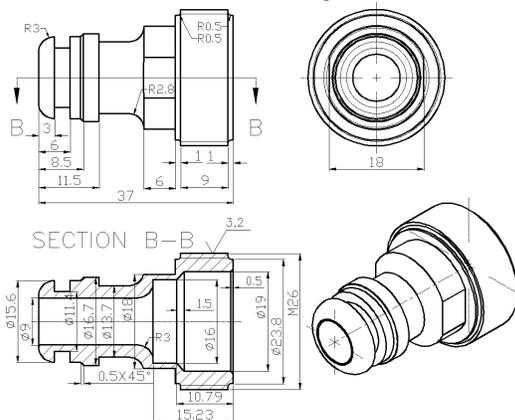
Fig. 7 Sprinkler nozzle drawing

5. Listing/sizing all orthogonal projections and adding annotations as necessary.

4. STEPS FOR OBTAINING THE SPRINKLER TYPE ASSEMBLY

Once all 3D landmarks of the assembly have been done, we can proceed to obtain the three-dimensional version. For this the following steps should be run through:
1. Open a new file with DWG extension.
2. Choosing from the "Main Desktop" the option "Assembly Modelling" which allows the generation of new context sets specific

to creating assemblies.

3. Activating "Assembly Catalogue" to add the directory which includes all the designed items, which cause all the file names for sprinkler to occur in the window called 'Part and Subassembly Definitions "as shown in Figure 8.
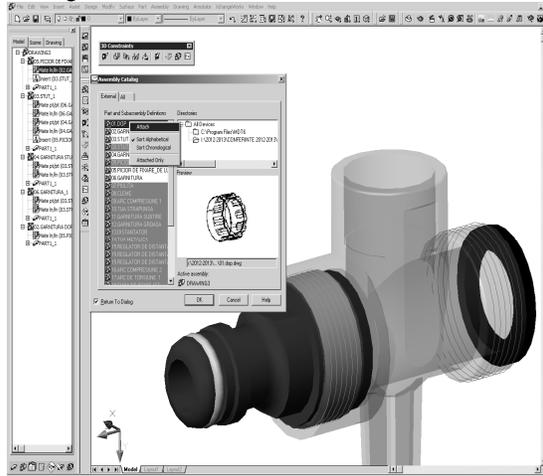
Fig. 8 „Assembly Catalogue" window

4. Selecting the basic item to be considered fixed and the position in space of other parts to be inserted into the set will be restricted too.
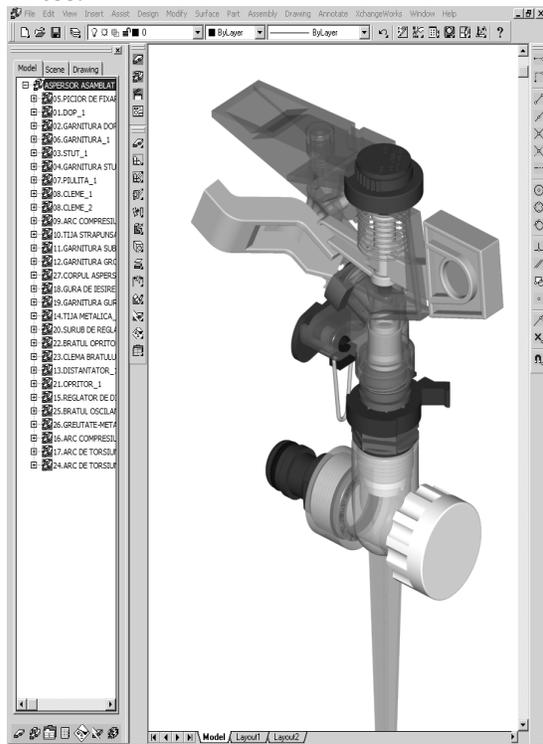
Fig. 9 3D assembly of the sprinkler

5. Imposing relative 3D positioning for each item separately, during inserting the

elements one by one, until the final assembly of the sprinkler is obtained (Figure 9).

5. CONCLUSIONS

Based on the previous chapters presented, it can be concluded that the scope of Mechanical Desktop software can be enlarged to cover agricultural equipment from the mechanization sector. In terms of getting the general view drawing of the axonometric representation of the sprinkler assembly type, positioning of the component parts is achieved automatically without meeting the Romanian standards in force, so it is necessary to relocate them manually, which involves increasing the design time.
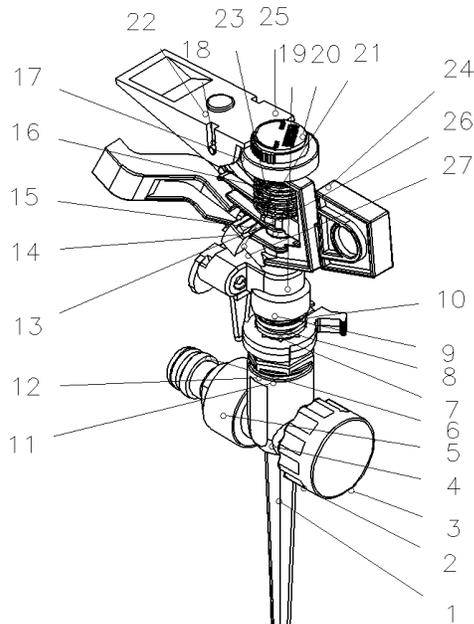
Fig. 10 Axonometric representation of the sprinkler

Figure 10 illustrates the sprinkler's axonometric projection, which is actually the end result of applying the steps mentioned throughout this paper.

REFERENCES

[1] **Stăncescu C.** „ Modelare parametrica si adaptiva cu Inventor", Publishing House FAST, Bucureşti 2009, ISBN 978-973-86798-4-9, vol. 2, pp. 81-82 .
[2] http://www.agropataki.ro/produse/irigatii_pentru_agricultura/aspersoare/ro accessed on 8.02.2013.
[3] http://webbut.unitbv.ro/teze/rezumate/2010/rom/NedelcuMihail.pdf accessed on 8.02.2013.